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A CASE OF ADAMANTINOMA SHOWING EPITHELIAL PEARLS.

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TUMORS arising from embryonic structures of the teeth are comparatively rare. The majority of such neoplasms are reported as "odontomata." According to Mallory,<sup>1</sup> three types of tumors of the jaw are recognized as arising from embryonic remains of the enamel organ. These are:

1. The follicular cyst, which is the simplest. It consists of a cyst lined with pavement epithelium. The inner wall of the cyst often bears a single, rarely several to many teeth.

2. The adamantinoma, growing as branching masses of epithelial cells, of which those adjoining the stroma correspond to adamantoblasts while the others form the enamel pulp. Cysts often form, owing to distention and coalescence of the vacuoles lying between the cells corresponding to those in the enamel pulp. Other cysts, which may be more numerous and larger, often occur in the connective tissue of the stroma as the result of focal collections of fluid. Blood-vessels will always be found running through this second form of cyst. Rarely the cells corresponding to those in the enamel pulp assume a concentric arrangement or may even form definite epithelial pearls. This result is not surprising, considering the origin of the enamel organ. The adamantinoma grows expansively only and

<sup>1</sup> Principles of Pathological Histology, second edition, p. 285.  
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does not produce metastases. Owing to its location and the size it sometimes reaches it may cause clinically much local disturbance.

3. The odontoma, which is produced by the conversion of fibroblasts adjoining the adamantoblasts into odontoblasts as a result of the action of the adamantoblasts upon the fibroblasts. When this happens separate teeth or fused masses of them may be produced by the differentiation of the odontoblasts with the adamantoblasts. Cementum may sometimes be formed. Occasionally the adamantinoma produces typical enamel.

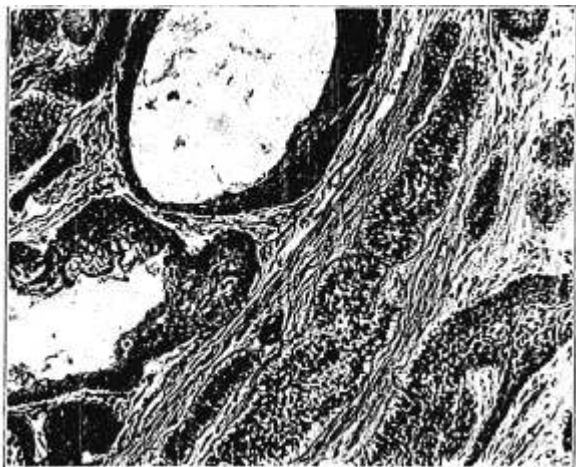


FIG. 1.—Adamantinoma. Cysts forming between pulp cells. Multiplied 150.

Adamantoblastoma, then, is a generic term like fibroblastoma, and covers the adamantinoma, developing from epiblastic cells which normally differentiate into adult enamel, and the odontoma, including not only the tumor structures of the adamantinoma, but also those structures arising from mesoblastic odontoblasts which normally differentiate into dental pulp, dentine, and cement. The structures of the adamantinoma are included in the odontoma because the structures of the latter are stimulated to growth by the action of the adamantoblasts upon the mesoblastic stroma, just as proliferative activity on the part of fibroblasts is incited by other tumor cells. The odontoma is a more highly differentiated type of adamantoblastoma just as a dermoid cyst is a more highly differentiated form of embryoblastoma than is a rapidly growing embryoma,

more commonly called a round or spindle-cell sarcoma or a carcinoma.

The adamantoblasts normally begin as an invagination of the oral epithelium and develop into the enamel organ covering the mesenchymal dental papilla. The enamel organ consists of an outer layer of enamel cells lying next to the surrounding gum and an inner layer of enamel cells lying next to the dental papilla. Between the two layers is the enamel pulp, consisting of epithelial cells corresponding to the prickle cells of the epidermis. "At first these internal cells are in close contact, like those of ordinary epithelium; but later, through vacuolization and accumulation of gelatinous, intercellular substance, they constitute a protoplasmic reticulum which resembles mesenchyma, and is known as the enamel pulp."<sup>2</sup> An excessive accumulation of this secretion, with abnormal coalescence and distention of the spaces, gives rise in tumors to cysts filled

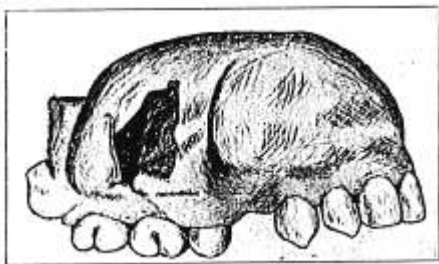


FIG. 2.—Adamantinoma reproduced with pen and ink from Kaiserling preservation of lateral half of specimen and from written description. (McCracklin.)

with gelatinous, sticky, semifluid material. Larger cysts are also formed in the stroma of such tumors by the accumulation of fluid, and are surrounded with cylindrical cells whose nuclei are away from the stroma, and hence from the cysts. These two kinds of cysts are characteristic of the cystic adamantoblastomas. In the normal embryonic enamel pulp no vessels or nerves are found, but in the stroma of neoplastic growths arising from remains of the enamel organ, vessels do occur as they do in the stroma of all tumors. The larger cysts form about these vessels.

In the process of invagination and development of the enamel organ the inner enamel cells (ameloblasts) elongate and become the enamel-producing cells (adamantoblasts). According to Lewis and Stohr<sup>3</sup> "the ameloblasts produce enamel along their basal surfaces, which are toward the dental papilla; but they become so trans-

<sup>2</sup> Lewis and Stohr: *A Text-book of Histology*, second edition, p. 102.

<sup>3</sup> *Loc. cit.*

formed that their basal surfaces appear like free surfaces and the entire cells seem inverted. In columnar epithelial cells the nuclei are generally basal and the secretion gathers near the free surface, but in the ameloblasts these conditions are reversed. The nuclei are toward the enamel pulp and the latter forms a dense layer over the ameloblasts," while what were the basal ends of the cells before invagination, which now lie next to the dental papilla, appear free and without nuclei. In the microscopic picture of adamantoblastoma most of the cysts are in the stroma, as a rule, and are lined with the apparent free ends of the cylindrical epithelium whose nuclei are in the opposite ends away from the cysts. In other words, the



FIG. 3.—Adamantinoma, from photograph of Kaiserling. Preservation of lateral half of specimen.

ends which were basal before invagination and contained the nuclei are now free and adjacent to the cysts in the stroma. This is another characteristic picture of adamantoblastoma.

In connection with the case herein reported it is interesting to note that it occurred in a negro child. Miller,<sup>4</sup> in presenting clinically a case of unilateral odontoma of the superior maxilla in a two-year-old colored child, diagnosed with the aid of skiagrams which showed numerous widely scattered teeth, says: "Slowly growing unilateral jaw tumors are not infrequent in colored people and often attain huge size. These are commonly odontomata or

<sup>4</sup> Philadelphia Acad. Surg., 1914, xvi, 35.

adamantine in character." Westmoreland,<sup>5</sup> in presenting a tumor which he called a "follicular odontoma" in Bland-Sutton's classification, made the observation that these tumors seemed to be disappearing, he not having seen a case for years, although he had operated on 5 cases and his father on 38, all save one in negroes.

This report is submitted because it is that of an adamantinoma developing purely from adamantoblasts, shows epithelial pearls, and occurred in a sixteen-year-old negro boy. The specimen was removed by Dr. H. H. Grant from the superior maxilla on March 1, 1916, in the Louisville City Hospital and was sent to the laboratory with a clinical diagnosis of osteosarcoma. The tumor had been first

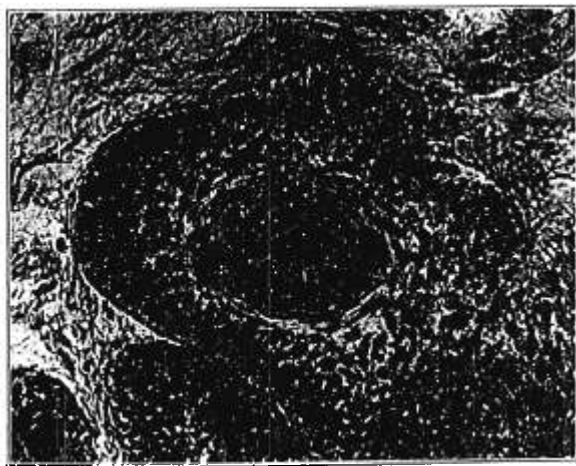


FIG. 4.—Adamantinoma, showing epithelial pearls. Multiplied 400.

noticed about one year before as a swelling of the gum, had grown gradually and been painless. The gross description of the specimen is as follows:

**GROSS DESCRIPTION.** Specimen consists of a portion of right superior maxilla with tumor. Three incisors, one canine, two molars, and adjacent bicuspid are present in their normal positions. Shaft of bone is severed transversely 1 cm. outside of lateral molar. Its superior surface is smooth and covered with muscle. Medial end is 2 cm. at left of cleft, between middle incisors. Anterosuperior surface bears a rounded mass covering practically all the surface.

Mass presents a cavity extending from upper to lower margins of specimen, 25 mm. wide and 15 mm. deep anteroposteriorly. This cavity is covered in front with a firm, cartilaginous shell, 1 to 3 mm. thick, and opens anteriorly in lower portion through an orifice 15 x 25 mm. Inner surface of cavity is smooth and does not present any teeth. Greater portion of remainder is smooth, moderately firm, and covered with a fibrous capsule bearing tags of muscle in upper portion, and presents a transverse, ragged crevice, apparently artificial. Tumor mass extends around underneath gum between canine and lateral bicuspid. In this space it is smooth, pale, and moderately firm. On sagittal section, through middle of mass, cut surface presents inferiorly, hard, cancellous bone 7 mm. thick, which extends upward about two-thirds of circumference of posterior surface. Anterosuperiorly tumor is bounded by a very thin, pale, white shell. Between these limits the tissue varies from white and pale gray, firm tissue to soft, pink and pale creamy brown tissue. Scattered in cut surface are small, irregular, pale spots cartilaginous to bony in consistency. On sagittal section through bicuspid there is opened anteriorly a smooth-walled cyst, unilocular, bounded by a thin, pale membrane, and containing pale brown fluid material distinctly gelatinous. It sticks to fingers like secretion from thyroid. This cyst is 15 mm. in greatest diameter and its bottom is 12 mm. above root of bicuspid. A smaller, similar cyst lies peripherally at superoposterior border of the specimen. Another sagittal section medial to first shows cut surface circumscribed as others, but solid and varying from pale gray to straw color and from bony hardness to soft. From surface of this is given off considerably more stringy, gelatinous material. After fixation numerous small holes are seen in cut surface. Sagittal section of one tooth in normal position shows root imbedded in maxilla at base of tumor mass. Sections of one-half of the specimen do not reveal any signs of teeth within the tumor.

**MICROSCOPIC DESCRIPTION.** Ten sections through different parts of the tumor show more or less similar structures; small to fairly large, irregular, sharply outlined, branching masses of compact cells. The grouping of the tumor cells suggests the arrangement of the compact epithelial cells in a hair matrix carcinoma. These are supported by a fibroblastic stroma in which is seen an occasional small vessel. The tumor cells are round to spindle in shape, have very little cytoplasm and contain small, fairly deeply staining nuclei. The cells about the peripheries are high columnar in type and have oval nuclei in the ends away from the stroma. Many of the tumor cell groups near their centers exhibit cells with vacuolization and small to moderately large cavities in which is a finely beaded material which stains homogeneously with eosin-like fine droplets of colloid. Some cells are in concentric layers like epithelial pearls. Some of these cavities are large and surrounded only with a rim

of tumor cells which are cuboidal rather than columnar at the periphery. Some of the sections show particles of bone in the stroma. Section from the block cut sagittally through a tooth shows a normal tooth outside the tumor.

**MICROSCOPIC DIAGNOSIS.** Adamantinoma.

In conclusion, I wish to express thanks to Professor F. B. Mallory for critically reviewing this article and the sections; to Mr. L. S. Brown, of the Massachusetts General Hospital Laboratory for his kindness in making the photomicrographs, and to Mr. Walter McCrocklin, a student in our laboratory, for the sketch drawn from the museum preparation of half the gross specimen and from the description in the laboratory records.

**NOTE.**—Since this article was written the boy reported five months after operation and showed no sign of recurrence.

## THE PATHOLOGICAL AND CLINICAL ASPECTS OF THROMBO-ANGITIS OBLITERANS.<sup>1</sup>

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It is not my purpose to burden you with an extensive and detailed account of the pathological and clinical aspects of the disease thrombo-angiitis obliterans, because the clinical picture and the main facts regarding the pathological lesions are certainly sufficiently known to you. I shall attempt, rather, to present the subject matter from the view-point of one who has been fortunate enough to have had a large amount of clinical material at his disposal (more than 300 cases), from which all phases of the pathology and clinical course could be investigated.

Perhaps the best general view of the morbid process, the most thorough understanding and most satisfactory conception can be had by a general comparative consideration of the pathological lesions and their corresponding clinical manifestations.

If I were asked to formulate a general concept of thrombo-angiitis obliterans I should answer as follows: Imagine a patient seeking relief for acutely swollen superficial veins of the lower or upper extremities, of sudden advent, and with all the manifestations of an acute thrombophlebitis. Imagine this process involving a considerable portion of the distal territory of the internal saphenous vein, followed by abatement of symptoms, and consequent resolution or healing. You will be in no doubt as to the general pathology nor as to the clinical course of the condition,

<sup>1</sup> Read before the College of Physicians of Philadelphia.